Benchmarking with Delphi Expert Opinion Panels

The Regional Municipality of Ottawa-Carleton Land Evaluation and Area Review (OCLEAR) System for Agriculture

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The results from the following study are specific to the Ottawa-Carleton Land Evaluation and Area Review System (OCLEAR) for Agriculture and are not intended to apply to other municipal Land Evaluation systems. Should you have any questions or comments involving the contents of this study, please contact Gary McTavish, Rural Planner (OMAFRA - Kemptville) at (613) 258-8306 or gmctavis@omafra.gov.on.ca

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Benchmarking with Delphi Expert Opinion Panels:

The Regional Municipality of Ottawa-Carleton Land Evaluation and Area Review (OCLEAR) for Agriculture

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Introduction

The Provincial Policy Statement (Section 2.1) requires that municipalities protect prime agricultural areas for long-term agricultural use. These areas are defined as those where Canada Land Inventory Soil Classes 1, 2 and 3 predominate. Alternatively, the PPS does provide for the identification of these areas through the use of an alternative agricultural land evaluation system approved by the Province. In order to assist municipalities in this regard, the Province of Ontario has developed the Land Evaluation and Area Review (LEAR) System - Draft (OMAFRA, 1997).

As part of the current review of the Regional Official Plan, the Regional Municipality of Ottawa-Carleton attempted to identify its prime agricultural areas by utilizing the LEAR system as the framework for a Regional model. The Region has since completed its Ottawa-Carleton LEAR (OCLEAR) process and have used the results to help identify its Agriculture Resource Area designation in its new Regional Official Plan (MMAH approved, October 1997).

"As with any model, [LEAR] systems are generalizations on reality, subject to errors of both commission and omission. The overall goal should be to combine simplicity with maximum information content" (Pease and Coughlin,1996, p.101)". In order to achieve this goal, it is important to evaluate the accuracy and reliability of any Land Evaluation/Area Review (LEAR) system and its results in order to:

(1) strengthen the concept of LEAR as an alternative agricultural land evaluation method; and

(2) substantiate its role in the municipal decision-making process regarding land use.

One method to accomplish such validation is to undertake a comparison of specific LEAR Evaluation Units with a measurement benchmark which is assumed to be more accurate. One approach to benchmarking is the Delphi Expert Opinion Method which can be used to establish benchmarking ratings for individual Evaluation Units by using agricultural experts. This validation of a LEAR system and its results will only become apparent when accepted by those people that are knowledgeable about agriculture and land use planning. One must assume that should the LEAR results be consistent with the opinions of experts, then decision-makers in the land use planning process will also feel comfortable with the system and confident in its results.

Hypothesis

The hypothesis put forward is that the OCLEAR rating system developed by the Regional Municipality of Ottawa-Carleton is accurate, consistent and dependable. When compared to other methods of rating lands for long-term agricultural suitability, the OCLEAR model generally provides accurate ratings on the quality of the soil and site characteristics on a relative scale. However, it is to be expected that our research will identify parts of the LEAR system that can be altered slightly to make the model more productive.

Ottawa-Carleton LEAR (OCLEAR)

As previously mentioned, each municipality has the opportunity to adjust the model so that it best suits their agricultural position. While the Region already has an "Agricultural Resource Area" designation in place through its current Official Plan, the OCLEAR was considered to be a more objective approach to identifying lands for protection.

The highlights of the system are outlined below:

- The **OCLEAR** system provides a maximum of 200 points for any Evaluation Unit (property holding) with Land Evaluation (LE) receiving 70% of the total weight and Area Review (AR) with 30%.

- **Land Evaluation (LE)** is based on soil capability and is used to determine the importance of an area's soil resources in terms of their use for agriculture. Points are allotted to each classification of soil on a scale of 0 to 10, the better the class - the higher the points received (e.g. Classes 1 and 2 soils receive 10 points, whereas Class 7 and Organic soils receive 0 points). Soil points are then multiplied by 14 for the total weighted LE score.

- **Area Review (AR)** is broken down into 3 separate factors.
  - Agricultural Land Use (AG), where a maximum of 10 points can be achieved depending on the percentage of property in agricultural use. The maximum score of 10 points can be attained should greater than 85% of the property be in agricultural use. The score is then multiplied by 3 for the total weighted AG score.
  - Fragmentation (FRAG) essentially involves parcel size - the larger the parcel size, the higher the score. Maximum score can be received 10 points if the land is over 36 hectares (90 acres) in size. For the total FRAG score, points are multiplied by 2 for the total weighted FRAG score.
  - Adjacent Land Use (AG-NEIGH) factor represents the percentage of property within 305 metres of an incompatible use and is rated on a scale of 10 points. The maximum is received if no portion of the property falls within the 305 metres sphere of influence, the score is then multiplied by 1 for the total weighted AG-NEIGH score.

- In completing its agricultural land evaluation system, the Region employed the expertise of an Agricultural Advisory Committee which greatly added credibility to the selection and scaling of factors. In addition, the Region's Geographic Information System was utilized to calculate OCLEAR scores and spatially display the resulting information (RMOC, 1997).

In the review of the OCLEAR results there was limited comparison with lands within the existing "Agriculture" designation until the draft Plan Schedule had been finalized. This comparison did not focus on individual Evaluation Units and their corresponding OCLEAR scores but rather provided some historical reference for designation boundaries.

Given the superficial benchmarking that the existing "Agriculture" designation provided and the change in criteria for prime agricultural lands (e.g. Class 4 no longer considered as prime agricultural land), it would appear that a Delphi Expert Opinion Panel could provide invaluable information as to the accuracy and reliability of the OCLEAR. In addition, the results of the Delphi method could serve as a useful reference for the Provincial LEAR.

Delphi Expert Opinion Method

Introduction

The Delphi method is a means of systematically collecting and progressively refining information provided by a group of selected experts (Linstone and Turoff, 1975). Delphi is characterized by response anonymity, controlled feedback and statistical summary of group responses. Anonymity reduces the effect of dominant individuals while controlled feedback (e.g. conducting the exercise in a sequence of rounds between which a summary of the previous round is communicated to the participants) reduces the range of answers and focuses on group consensus. Statistical summary is a means to reduce the group pressure for conformity and assures that the opinion of every Panelist is represented in the final ratings (Sussman, 1992). [In other words,] the less informed responses gravitate towards the more informed responses on each successive round (Pease and Coughlin, 1996).

Previous studies using this approach for LEAR-type validations would appear to indicate that Delphi is a reliable method to rate the agricultural potential of individual Evaluation Units for the purposes of determining an evaluation benchmark (Pease and Sussman, 1994).

Panel Selection

With respect to the OCLEAR Delphi Panel, the selection process focused on the individual's expertise in the field of agriculture and/or land use planning. While it was initially anticipated that the number of panel 'experts' would be between 12-16 to allow for a broader range of expertise

and expanded feedback, in the end, 8 individuals were invited to participate. As indicated above, the broad selection criteria involved agriculture and planning. Nonetheless, there was a conscious effort to ensure specific expertise within each discipline was also represented (e.g. Soils, Farm Business Management, Agricultural Extension - Rural Planning, Environmental Management).

In order to gain some further insight into individuals' perceived level of expertise, a pre-Delphi questionnaire was administered (Figure 2). The intent of this exercise was for the experts themselves to rank their level of expertise in a number of agricultural and planning areas against those other ' in the Panel. This information provided a reference point for a post-Delphi questionnaire to determine any change in the Panel members view of their expertise in relation to the entire Panel upon completion of the Delphi process (Figure 3). Results of these questionnaires will be discussed in further details in a following section.

Project Methodology

While benchmarking could potentially involve the review of factor scaling, it is intended that this exercise will focus on the scoring of the Land Evaluation (LE) and Area Review (AR) factors, the LE:AR ratio and the validation of the overall LEAR scoring. The Regional Land Evaluation factor is based on soil capability ratings as determined by the Canada Land Inventory methodology (OIP Report No. 58, 1987 and Soil Survey Report No. 47, 1979) which is a consistent data source. Nonetheless, the experts were afforded an opportunity to rate soil capability in order to gauge their confidence in the soil survey data. The exclusion of factor scaling is due to the need to streamline the Delphi process and maximize study resources..

To carry out the validation, a five-step approach was undertaken:

(1) Within the Region, 25 Evaluation Units (individual properties) were selected. These Units represented diverse physical and spatial characteristics. Factors considered in Unit selection included soil type, landscape diversity, geographic location, current land use, surrounding development and parcel size.

(2) A panel of agricultural and planning experts (8) were invited to review these Units during a field tour and requested to rate the Units in terms of:

(a) Land Evaluation (LE) the suitability of soils;

(b) Area Review (AR) factors considered important to maintaining agriculture; and

(c) an appropriate LE:AR ratio;

(3) Complete a LEAR rating on the 25 Evaluation Units using the Delphi Method which involved 3 iterations of the above property characteristics ratings and LE:AR ratio. Each panelist received a copy of the property assessment for the site location which included lot sizes and a soil capability overlay. As well, each individual received a colour air photo with the site identified. This information was supplemented by a 1-day field tour to the sites.

(4) Once all the Delphi ratings / ratio was completed, panelists were requested to determine a singular threshold value that would indicate the break between lands of high and low agriculture potential; and

(5) Upon completion, the reliability of the OCLEAR ratings was analyzed utilizing the Delphi ratings as a benchmark.

Analysis

The results from this project are discussed in two separate parts:

(1) the Delphi process;

(2) a comparison of the Delphi scores to those provided by the OCLEAR, and;

(3) the Delphi Panel Self-Assessment.

(1) The Delphi Process

For each Delphi round, the median and interquartile range of the panel's scores were produced and shared with the panel members (Tables 1, 2 and 3). Between Rounds One and Two, there was considerable convergence of the

interquartile ranges (Soil = 24 sites / Other Factors = 19 / Overall = 17), however, between Rounds Two and Three, the interquartile range only narrowed occasionally (Soils = 5 / Other Factors = 8 / Overall = 12). Changes in the median scores from Rounds One to Two were not as dramatic (Soils = 7 / Other Factors = 7 / Overall = 16), as were those for Soils (3) and Other Factors (2) between Rounds Two and Three. However, median values did change for the Overall scores (12) between Rounds Two and Three indicating that Delphi was a somewhat effective method for achieving group consensus.

(2) Comparison of the Ottawa-Carleton LEAR and Delphi Results

The final median results from the Delphi Panel were compared to the OCLEAR scores by looking at the numeric differences between the two ratings, a statistical test of correlation between the relative rankings of all twenty-five sites for the two processes and by examining the relative weights given to LE and AR. The Delphi panel used a 200 point scale (soils 100 / other 100), which was later converted to correspond to the OCLEAR's 200 point scale (soils 140 / other 60).

Differences and Percentage Error

As mentioned above, in order to complete a comparison, each component of the Delphi score was converted to the same scale as the OCLEAR. Median Land Evaluation (LE) scores were multiplied by 1.4 and Area Review (AR) scores by 0.6, thereby creating an equivalent Overall score. Following scale equalization, the difference between the Delphi and OCLEAR was established (Delphi minus OCLEAR) as well as the percentage error (Delphi minus OCLEAR divided by Delphi x 100). Complete results of this comparison are available in Tables 4, 5 and 6.

Comparing the **soil ratings (LE)** (Table1), it can be seen that the Delphi panel consistently rated sites lower than the OCLEAR (19 out of 25 sites), particular Sites 8 (-) and 16 (-). Including all sites, the average difference between the Delphi and the OCLEAR soil ratings was -8.1 points. When excluding Sites 8 and 16, the average difference is -5.3 points.

A review of both Sites 8 and 16 indicates that while both locations are rated as predominately Class 2 soils, they occur within a broader area of lower capability soils with stoniness and bedrock limitations with low intensity agriculture. Given the surrounding soil characteristics and questions

raised by several Delphi members regarding the accuracy of the soil capability mapping, it is not surprising that these Sites scored less points than the information-based OCLEAR. Conversely, Sites 4 (+28) and 24 (+17.5) received higher scores from the Delphi panel than the OCLEAR probably due to the soil capability at these locations. The published soil mapping rates the sites as Class 4 soils yet the lands have historically been intensively cropped (corn; soybean). Once again, the Delphi panel may have challenged the existing soil information and assigned their own higher soil rating to the properties. These site-specific adjustments illustrate the advantage of a Delphi panel with local knowledge over a general LEAR model which is data-driven and cannot reflect a wide variety of site-specific factors.

In comparing the **other factor ratings (AR)** (Table 4), it is noted that once again the Delphi panel consistently rated the selected sites lower than the OCLEAR (20 out of 25 sites) with a average difference of -6.6 points. Of those sites that the Delphi rated as higher, Site 11 had the largest difference with Delphi scoring the property at 22 points above the OCLEAR (% error of 49). This discrepancy would seem to reflect the perception of smaller parcel sizes and their appropriateness for long-term agriculture. The OCLEAR simply scores fragmentation based on parcel size (hectares) with smaller properties being penalized. It is clear that while the Delphi panel was concerned with smaller parcel sizes, Site 11 (10.6 ha) consisted of high capability soils and was located within a large, contiguous farm area which heightened the potential for this parcel to be used for agriculture, either individually or in conjunction with other farm properties. Hence, the higher score from the Delphi panel.

Of the sites that the Delphi scored lower than the OCLEAR, the largest difference was with Sites 8 (-18.5 / 49 % error) and 9 (-19.4 / 53 % error). It should be noted that there were many other sites that had a percentage error of greater than 30, however, Sites 8 and 9 largely exemplify the different manner in which the Delphi panel viewed other factors' impact on agriculture. With respect to Site 8, it would appear that the long term potential for agriculture on this property was compromised by the lack of agricultural intensity within the surrounding area (low soil capability, non-farm residences, property fragmentation) The OCLEAR does not scan the nature of surrounding lands for any other use than designated urban areas (within 305 metres of property

boundary). However, given the complexity of the soils and the abundance of scattered rural residences within the rural area of the Regional Municipality, many pockets of high capability land are trapped in broader areas of poor quality soils which are not used for commercial agriculture. While the number of conflicting land uses may not be of an immediate concern for conflict, there is an unwillingness for a farmer to invest in farm infrastructure in locations where fragmentation and property values are seen to be on the way up. This is an important observation for future Land Evaluation systems to address when determining means to measure the impacts from surrounding lands.

Site 9 represents a different twist on the Delphi panel interpretation of the other factors that influence agriculture. While this site predominantly consists of Class 2 soils and is not comparatively small (22.6 ha), the property is located immediately adjacent to a rural residential hamlet. However, it does not appear that the degree of impact from proximity to conflicting urban uses differs greatly from the OCLEAR to Delphi. Rather, it is the physical characteristics of the parcel that allow for a lower Delphi score. The site is dissected by several severe gullies that fragment the property into series of small fields which are only accessible from different road entrances. As mentioned previously, it is these types of localized details that the Delphi panel can draw upon that the OCLEAR cannot.

In comparing the **overall ratings** (Table 6) which were generated from the median overall scores as assigned by the Delphi panel members, it is not surprising to note that again the Delphi scores are consistently lower than the OCLEAR scores. The average difference between the two methods was -10.85 points with the Delphi scoring 19 out of 25 sites lower than the OCLEAR. The increase in absolute point difference largely represents the compounding of the soil and other factor discrepancies.

Relative Rankings

The OCLEAR system was analyzed to understand the relationship between it's site rankings and those of the Delphi panel. In order to determine if a correlation of ranks existed, Spearman's

Coefficient of Rank Correlation Equation was utilized (Sincich, 1993). It should be noted that as some sites tied in ranking, the sample coefficient of correlation may deviate may from the actual coefficient correlation. Therefore, the calculated coefficients can only be viewed as approximate. In addition, as LEAR scores are linearly dependent, a test of statistical significance of rank correlation of all three LEAR components (Land Evaluation; Area Review; Overall) would be redundant (Sussman, 1992). Given the above, the only score used to find a correlation is the Overall Score (Table 9). A correlation of +1 represents perfect agreement, while a correlation of -1 indicates perfect disagreement.

A review of the relative rankings for the **soil** (LE) scores illustrates that the Delphi panel generally followed the soil capability mapping that was provided with better soils ranking higher than lower capability soils. This type of approach matches well with the OCLEAR system as it also bases soil scores on their capability for agriculture in descending order of classification. When using Spearman's equation, the rank correlation of the soil ratings was calculated to be 0.874, which shows strong agreement in relative soil rankings (Table 7).

In the relative ranking of **other factor** (AR) scores, the coefficient of correlation was calculated to be 0.276, which represents a weak agreement between the Delphi panel and the OCLEAR system (Table 8). When reviewing the rankings of the OCLEAR, it could be argued that the correlation has been weakened by the large number of tie rankings which have the effect of broadening the difference (Di) between the Delphi and OCLEAR. However, if the OCLEAR rankings are strictly placed in descending order (no tie rankings), the coefficient of correlation only marginally improves to 0.413.

Like soils, rank correlation appears strong for the median Overall Scores (Table 9). Both the Delphi and OCLEAR ranked Site 14 as the lowest with the next lowest rankings being separated by only 1 rank position (Delphi Sites 17, 11 and 6). With respect to the highest ranking sites, the OCLEAR ranking was only one rank below the Delphi high site. However, the relative ranking positions diverged slightly through the descending ranks.

Using Spearman's equation, a coefficient of rank correlation of 0.840 was calculated for the Overall Scores (with a confidence interval of 95 %, rejection would occur if correlation is <0.366). The above correlation would appear to indicate that the Delphi panel and the OCLEAR system ranked the sites for soils and overall scores in a similar fashion. Due to the Delphi scores being normalized to the OCLEAR ratio of 70:30, many of the large differences in other factor (AR) scoring for the two systems have been diluted. As such, the weak correlation of the other factors does not significantly affect the overall correlation as it is largely based on soil scoring.

Ratio: Soil (LE) to Other Factors (AR)

At the conclusion of the Delphi scoring rounds, panel members were requested to provide a appropriate LE : AR ratio. While some panel members applied their desired ratios within the scoring rounds, at least implicitly, other members did not and therefore, all were afforded the opportunity to indicate a suitable ratio. The Delphi panel ratio (55 : 45) was applied to both the Delphi and the OCLEAR overall scores in order to see whether the difference between the two rating systems would be narrowed. As was the case with the existing OCLEAR ratio (70 : 30), a review of the Delphi panel ratio (Table 10) illustrates that the Delphi panel consistently scored sites lower (22 of 25) than the OCLEAR system by an average of -16 points with the largest difference being site 8 (-61 / 47 % error). When using Spearman's equation, the coefficient of rank correlation for a 55 : 45 ratio was calculated to be 0.806 (Table 11). While this may represent some degree of agreement between the two evaluation systems, the correlation is weaker than that of the initial ratio (70 : 30).

In their early efforts to promote land evaluation techniques, U.S. Department of Agriculture - Soil Conservation Service developed the National Land Evaluation and Site Assessment Handbook (USDA, 1983) which put forward a ratio of 33 : 67. While the revised Guidebook (SWCS, 1996) no longer promotes the use of singular ratios between the Land Evaluation (LE) and Area Review (AR) components, it was felt that such an analysis using this ratio may still prove insightful and was supported by some Delphi members who had listed a similar ratio (30 : 70). Once again, the Delphi panel consistently scored the sites lower (20 of 25) than the OCLEAR with the average

difference (Table 12) increasing to -19.5 points with site 8 having the greatest difference at -61 points (47 % error). When applying the Spearman equation, the coefficient of rank correlation is seen to be 0.727 (Table 13) which is significantly weaker correlation than the initial LE : AR ratio (70 : 30).

Thresholds

Following the final Delphi iteration, each expert was also asked to determine a threshold value which would act as a break between good and poor agricultural land. This value would serve as the guiding point from which decision-makers could determine planning policies to recognize and protect prime agricultural lands. Coincidentally, the median Delphi threshold was 130 points which represented the same threshold as was selected through the OCLEAR process. When comparing the median Overall Scores (70 : 30), a firm threshold of 130 points would recognize 17 sites (Delphi) and 18 sites (OCLEAR) as lands that have long-term agricultural potential. Of these sites, 15 were agreed upon by both the Delphi and OCLEAR systems.

Of the remaining sites that had no agreement, there was at most a 14 point range (site 1) below the 130 point threshold with most sites being only a few points below (sites 1, 3, 5, 24). While 3 of the 5 sites (1, 4, 5) have an absolute difference greater than the average difference, there are no significant variations that would indicate total disagreement between Delphi and OCLEAR as to a site's agricultural potential for protection purposes. In point, this analysis supports the need for a threshold range ('fuzzy / grey zone") to allow for an additional review of sites that are 'on the edge' or alternatively, establish separate thresholds for selected factors and overall scores.

(3) Delphi Panel Self-Assessment

As noted previously, at the conclusion of each Delphi round, the median, upper and lower quartile scores were produced from the results of the panelists' ratings. One can see from the results that each expert was reluctant to significantly alter their scores, however the gaps between quartiles were narrowed as the rounds progressed. Although the results still showed a difference between

quartiles and the median, with little change between rounds it was believed another round would have proved unnecessary. While the ratings of each panelist may not illustrate a high degree of group consensus, individual rankings of the twenty-five sites showed a close comparison.

This lack of consensus was not surprising given the confidence expressed by each panelist in terms of their level of expertise when compared to the rest of the group through the pre / post-Delphi questionnaires (Figures 1 and 2). Those individuals who indicated a high degree of comfort in their expertise at the outset of the Delphi project generally did not change their position during post-Delphi questioning. Similarly, those with lower confidence levels did not greatly improve their assessment from the beginning to end of the process. Interestingly, there was little relationship between an expert's high level of self-assessment and their accuracy in determining median Delphi ratings. As the selection of panelists attempted to capture a range of experiences in the areas of agriculture and planning, the lack of shift in perception of expertise and group consensus may be the result of several panelists' markedly different perspectives on the topic of agricultural land identification. In the end, it was felt that this divergence was a positive influence on the Delphi procedure and enhanced the results.

Summary

In all, the OCLEAR system generally provides an accurate ratings of the long-term agricultural potential of individual land parcels. However, this accuracy is not especially evident when reviewing the comparison of 'Other Factors' (AR) between the OCLEAR and the Delphi. Strong rank correlation for the Overall Scores was primarily the result of a substantial 'soil capability' (LE) weighting (70 %) which overshadowed the weak agreement between the two system's 'other factors' scores. This result is further illustrated when the LE : AR ratio is changed to account for a higher AR weighting (55 : 45 / 33 : 67) which has the effect of lowering the rank correlation.

In addition to the ratio differences, the AR disparity may be the result of specific factor weightings. In the OCLEAR, AR factors of land use [15%], conflicting land use [5%] and parcel

size [10%] were individually weighted with the aggregate weighting equally the 30 % ratio. Conversely, the Delphi panel scores were based on each member's own AR factors and did not necessarily involve any weighting among factors. While Delphi members may have applied their own weighting implicitly, this weighting was probably adjusted from site to site. Due to these disparities in AR scoring, it may be more beneficial to undertake a 'policy Delphi' process to achieve group consensus on matters such as factor selection, scaling and weighting before completing a conventional Delphi process (Bagley, 1997).

With respect to the application of the Delphi method to the soil factor, there may be a resource savings to be gained by not including this component. As the soil capability information is based on consistent data sources and would appear to have a strong agreement between the two systems, it may be worthwhile to focus on the AR factors. Nonetheless, should the quality of the soil data be lacking in a particular study area, it may prove useful to include the soil component in the Delphi procedure.

A benchmark validation using a local expert panel in a systematic procedure such as Delphi is critical to the LEAR validation process lending credibility to the results and strengthening decision-makers resolve to protect prime agricultural lands. As a result of this study, it is evident that the overall OCLEAR system is accurate and consistent and represents a step forward to agricultural protection in the Regional Municipality.

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Table 1: Ottawa-Carleton Delphi Panel Scores, by round - SOILS

Site		Round1	Round2	Round3
1	Upper	58.75	56.25	56.25
	Median	52.5	52.5	52.5
	Lower	47.5	47.5	47.5
2	Upper	90	90	90
	Median	85.5	85.5	85.5
	Lower	83.75	85	85
3	Upper	70	70	70
	Median	62.5	62.5	62.5
	Lower	55	56.25	56.25
4	Upper	72	70.25	70.25
	Median	70	70	70
	Lower	57.5	60	60
5	Upper	70	65.75	64.25
	Median	62	62	61.5
	Lower	57.5	57.5	57.5
6	Upper	60	50	50
	Median	42	42	42
	Lower	38.75	38.75	38.75
7	Upper	70.5	70	63.5
	Median	61	61	60
	Lower	56.25	56.25	56.25
8	Upper	80.5	80	76.25
	Median	65	68	68
	Lower	50	50	50
9	Upper	80.5	80.5	80.5
	Median	79	80	80
	Lower	73.75	77.25	77.25
10	Upper	90	90	90
	Median	85.5	86	86
	Lower	80	83	83
11	Upper	39.25	36.25	36.25
	Median	33.5	33.5	33.5
	Lower	30	30	30
12	Upper	55.75	54.25	54.25
	Median	50	50	50
	Lower	49.5	49.5	49
13	Upper	82.5	80	74.75
	Median	71.5	71.5	70
	Lower	64.25	68	68
14	Upper	36.25	35	35
	Median	30	30	30
	Lower	23.75	23.75	23.75
15	Upper	77.5	75	75
	Median	70	70	70
	Lower	70	70	70
16	Upper	88.5	85	85
	Median	80	80	80
	Lower	78.75	80	80
17	Upper	48.5	48.5	48.5
	Median	45	45	45
	Lower	41.25	43.75	43.75
18	Upper	80	75	75
	Median	75	75	75
	Lower	72.25	72.25	72.25
19	Upper	95	92.75	90.5
	Median	91	90	90
	Lower	88.75	88.75	88.75
20	Upper	90	90	90
	Median	87	87	87
	Lower	80	82.25	82.25
21	Upper	85	85	85
	Median	85	85	85
	Lower	80	80	80
22	Upper	86.25	85	85
	Median	83	83.5	83.5
	Lower	80	81.5	81.5
23	Upper	68.5	68	68
	Median	66.5	65	65
	Lower	63	63	63
24	Upper	65.25	65	65
	Median	62.5	62.5	62.5
	Lower	50	57.5	60
25	Upper	90	90	90
	Median	87.5	89	89
	Lower	83.75	84.75	84.75

Table 2: Ottawa-Carleton Delphi Panel Scores, by round - OTHER FACTORS

Site		Round1	Round2	Round3
1	Upper	72.5	70	70
	Median	62.5	67.5	67.5
	Lower	40	52.5	52.5
2	Upper	90	90	90
	Median	85	85	85
	Lower	83.75	83.75	83.75
3	Upper	68.75	81.25	81.25
	Median	62.5	62.5	62.5
	Lower	56.25	60	60
4	Upper	67	67	67
	Median	60	60	60
	Lower	47.5	48.75	56.25
5	Upper	70.75	70	70
	Median	62.5	62.5	62.5
	Lower	53.75	58.75	58.75
6	Upper	80	72.5	72.5
	Median	70	69	69
	Lower	58.75	62.5	62.5
7	Upper	73.5	73.5	73.5
	Median	70	70	70
	Lower	51.25	66.25	66.25
8	Upper	67	67	67
	Median	62.5	62.5	62.5
	Lower	58.75	58.75	58.75
9	Upper	67.5	65	65
	Median	61	61	61
	Lower	57.5	58.75	58.75
10	Upper	92.5	86.25	86.25
	Median	76.5	80	80
	Lower	70	72.25	72.25
11	Upper	86.25	76.25	76.25
	Median	75	75	75
	Lower	68.75	70	70
12	Upper	92.5	80	80
	Median	77.5	75	75
	Lower	67.5	69.5	69.5
13	Upper	82.5	80	80
	Median	80	80	80
	Lower	69.25	74.5	74.5

Site		Round1	Round2	Round3
14	Upper	80	80	80
	Median	70	70	70
	Lower	65.75	65.75	65.75
15	Upper	75	72.5	71.25
	Median	65.5	64.5	64.5
	Lower	60.5	57.5	57.5
16	Upper	80	80	80
	Median	80	80	80
	Lower	73.5	73.5	73.5
17	Upper	52.5	41.25	40.75
	Median	40	40	40
	Lower	30	30	37.5
18	Upper	70	70	70
	Median	66.5	67.5	68.75
	Lower	60	64.5	64.5
19	Upper	88.5	80.5	80.5
	Median	80	80	80
	Lower	75	75	77.25
20	Upper	94	92.75	92.75
	Median	90	90	90
	Lower	87.5	88.75	90
21	Upper	91.25	83.75	83.75
	Median	75	73.5	73.5
	Lower	67.25	69.5	70
22	Upper	82.5	81.25	81.25
	Median	79	79	79
	Lower	68.75	73	73
23	Upper	76.25	75	75
	Median	71.5	71.5	71.5
	Lower	59.5	63.25	67
24	Upper	72.5	71.25	71.25
	Median	69	69	69
	Lower	57.5	57.5	57.5
25	Upper	96.25	92.5	92.5
	Median	87.5	87.5	88.75
	Lower	80	80	83.75

Table 3: Ottawa-Carleton Delphi Panel Scores, by round - OVERALL

Site		Round1	Round2	Round3
1	Upper	135	135	130
	Median	122.5	120	120
	Lower	102.5	103.75	103.75
2	Upper	178.75	176.25	176.25
	Median	170.5	170.5	170.5
	Lower	168.75	170	170
3	Upper	135	135	135
	Median	125	125	125
	Lower	112.5	118.75	118.75
4	Upper	141	140	140
	Median	135	133.5	133.5
	Lower	112.5	116.25	116.25
5	Upper	142.5	134.75	132.5
	Median	124.5	127	126
	Lower	107.5	115	115
6	Upper	132.5	122.5	122.5
	Median	115	113.5	113.5
	Lower	100.5	105	105
7	Upper	141.25	141.25	136.5
	Median	133.5	133.5	131
	Lower	100	122.5	122.5
8	Upper	147.25	147.75	142.5
	Median	130	133.5	133.5
	Lower	108.75	108.75	108.75
9	Upper	146.25	143.25	143.25
	Median	140	140	140
	Lower	127.5	131.25	131.25
10	Upper	177.75	174	174
	Median	165	165	165
	Lower	159.25	159.25	159.25
11	Upper	120.5	122.5	114
	Median	113.5	110.5	109.5
	Lower	106.75	103.75	103.75
12	Upper	150	146.25	142.5
	Median	130	129	129
	Lower	120.5	118.25	118.5
13	Upper	162.5	160	160
	Median	156.5	156.5	151.5
	Lower	133.75	142.75	142.75
Site		**Round1**	**Round2**	**Round3**
14	Upper	112.5	106.25	106.25
	Median	107.5	98	98
	Lower	99.5	91.25	91.25
15	Upper	152.5	148.75	146.25
	Median	135.5	140	140
	Lower	129	134.25	134.25
16	Upper	168.5	161.25	161.25
	Median	159	159	159
	Lower	150	150	150
17	Upper	93.5	89.75	89.25
	Median	82.5	82.5	85
	Lower	76.25	76.25	76.25
18	Upper	151.25	152.5	174.25
	Median	142.5	145	170
	Lower	135.75	135.75	166
19	Upper	180	174.25	180
	Median	172.5	170	177.5
	Lower	167.5	167.5	168.75
20	Upper	180	180	168.75
	Median	180	177.5	157.5
	Lower	171.25	167.5	151
21	Upper	176.25	168.75	180
	Median	162.5	156	168.75
	Lower	148.75	149.5	177.5
22	Upper	172.5	170	170
	Median	161	163.5	163.5
	Lower	156.75	159	159
23	Upper	144.75	144.75	144.75
	Median	138.5	133.5	136
	Lower	125.75	125.75	129
24	Upper	134.75	134.75	134.75
	Median	123	128	130
	Lower	117.5	117.5	122
25	Upper	182.5	180	180
	Median	175	175	177.75
	Lower	168.75	164.75	168.5

Table 4: Delphi Ratings vs. OCLEAR Ratings

SOILS

Site	Size (hectares)	Location	Delphi Rating	New Delphi Rating ü	OCLEAR Rating**	Difference Delphi-OCLEAR	% Error
1	58.79	Rideau/North Gower	52.5	73.5	90	-16.5	22%
2	43	Rideau/Manotick	85.5	119.7	140	-20.3	17%
3	63.9	Rideau/Manotick	62.5	87.5	97	-9.5	11%
4	29.92	Goulbourn	70	98	70	28	29%
5	19.91	Goulbourn	61.5	86.1	105	-18.9	22%
6	40.59	Goulbourn	42	58.8	60	-1.2	2%
7	41.51	Goulbourn	60	84	79	5	6%
8	30.45	WestCarleton/Huntley	68	95.2	137	-41.8	44%
9	22.61	WestCarleton/Huntley	80	112	103	9	8%
10	12.81	WestCarleton/Fitzroy	86	120.4	140	-19.6	16%
11	10.63	WestCarleton/Fitzroy	33.5	46.9	55	-8.1	17%
12	20.52	WestCarleton/Fitzroy	50	70	62	8	11%
13	31.23	WestCarleton/Fitzroy	70	98	116	-18	18%
14	20.76	WestCarleton/Fitzroy	30	42	35	7	17%
15	28.53	WestCarleton/Torbolton	70	98	115	-17	17%
16	26.67	Kanata	80	112	150	-38	34%
17	14.76	WestCarleton/Huntley	45	63	70	-7	11%
18	42.01	Goulbourn	75	105	123	-18	17%
19	121.45	Nepean	90	126	136	-10	8%
20	83.7	Nepean	87	121.8	123	-1.2	1%
21	60.41	Nepean	85	119	123	-4	3%
22	47.7	Gloucester	83.5	116.9	119	-2.1	2%
23	48.74	Rideau/North Gower	65	91	108	-17	19%
24	27.93	Osgoode	62.5	87.5	70	17.5	20%
25	36.93	Osgoode	89	124.6	139	-14.4	12%

ü Delphi multiplied for fit ** Scores from the Region

Table 5: Delphi Ratings vs. OCLEAR Ratings

OTHER FACTORS

Site	Size (hectares)	Location	Delphi Rating	New Delphi	OCLEAR Rating**	Difference Delphi-OCLEAR	% Error
1	58.79	Rideau/North Gower	67.5	40.5	54	-13.5	33%
2	43	Rideau/Manotick	85	51	60	-9	18%
3	63.9	Rideau/Manotick	62.5	37.5	33	4.5	12%
4	29.92	Goulbourn	60	36	46	-10	28%
5	19.91	Goulbourn	62.5	37.5	50	-12.5	33%
6	40.59	Goulbourn	69	41.4	57	-15.6	38%
7	41.51	Goulbourn	70	42	60	-18	43%
8	30.45	WestCarleton/Huntley	62.5	37.5	56	-18.5	49%
9	22.61	WestCarleton/Huntley	61	36.6	56	-19.4	53%
10	12.81	WestCarleton/Fitzroy	80	48	44	4	8%
11	10.63	WestCarleton/Fitzroy	75	45	23	22	49%
12	20.52	WestCarleton/Fitzroy	75	45	56	-11	24%
13	31.23	WestCarleton/Fitzroy	80	48	56	-8	17%
14	20.76	WestCarleton/Fitzroy	70	42	34	8	19%
15	28.53	WestCarleton/Torbolton	64.5	38.7	54	-15.3	40%
16	26.67	Kanata	80	48	56	-8	17%
17	14.76	WestCarleton/Huntley	40	24	31	-7	29%
18	42.01	Goulbourn	67.5	40.5	51	-10.5	26%
19	121.45	Nepean	80	48	54	-6	13%
20	83.7	Nepean	90	54	60	-6	11%
21	60.41	Nepean	73.5	44.1	50	-5.9	13%
22	47.7	Gloucester	79	47.4	31	16.4	35%
23	48.74	Rideau/North Gower	71.5	42.9	51	-8.1	19%
24	27.93	Osgoode	69	41.4	56	-14.6	35%
25	36.93	Osgoode	87.5	52.5	57	-4.5	9%

* Median Other response

Table 6: Delphi Ratings vs. OCLEAR Ratings

OVERALL

Site	Size (hectares)	Location	Delphi Rating	OCLEAR Rating**	Difference Delphi-OCLEAR	% Error
1	58.79	Rideau/North Gower	120	144	-24	20%
2	43	Rideau/Manotick	170.5	200	-29.5	17%
3	63.9	Rideau/Manotick	125	130	-5	4%
4	29.92	Goulbourn	133.5	116	17.5	13%
5	19.91	Goulbourn	126	155	-29	23%
6	40.59	Goulbourn	113.5	117	-3.5	3%
7	41.51	Goulbourn	131	139	-8	6%
8	30.45	WestCarleton/Huntley	133.5	193	-59.5	45%
9	22.61	WestCarleton/Huntley	140	159	-19	14%
10	12.81	WestCarleton/Fitzroy	165	184	-19	12%
11	10.63	WestCarleton/Fitzroy	109.5	78	31.5	29%
12	20.52	WestCarleton/Fitzroy	129	118	11	9%
13	31.23	WestCarleton/Fitzroy	151.5	172	-20.5	14%
14	20.76	WestCarleton/Fitzroy	98	69	29	30%
15	28.53	WestCarleton/Torbolton	140	169	-29	21%
16	26.67	Kanata	159	196	-37	23%
17	14.76	WestCarleton/Huntley	85	101	-16	19%
18	42.01	Goulbourn	145	174	-29	20%
19	121.45	Nepean	170	190	-20	12%
20	83.7	Nepean	177.5	183	-5.5	3%
21	60.41	Nepean	157.5	173	-15.5	10%
22	47.7	Gloucester	163.5	150	13.5	8%
23	48.74	Rideau/North Gower	136	159	-23	17%
24	27.93	Osgoode	130	126	4	3%
25	36.93	Osgoode	177.75	196	-18.25	10%

* Median Overall response ** Scores from OCLEAR

Table 7: Relative Rank of Sites by Delphi and OCLEAR

Soils Scores (Ratio = 70:30)

Site	Delphi Rank	OCLEAR Rank	Di	Di2
1	20	17	3	9
2	5	2	3	9
3	16	16	0	0
4	12	19	-7	49
5	18	14	4	16
6	23	23	0	0
7	19	18	1	1
8	14	5	9	81
9	8	15	-7	49
10	4	2	2	4
11	24	24	0	0
12	21	22	-1	1
13	11	11	0	0
14	25	25	0	0
15	12	12	0	0
16	8	1	7	49
17	22	21	1	1
18	10	7	3	9
19	1	6	-5	25
20	3	7	-4	16
21	6	7	-1	1
22	7	10	-3	9
23	15	13	2	4
24	16	20	-4	16
25	2	4	-2	4
		Total =		353

Coefficient of rank correlation =0.874

Table 8: Relative Rank of Sites by Delphi and OCLEAR

Other Factor Scores (Ratio 70 : 30)

Site	Delphi Rank	OCLEAR Rank	Di	Di2
1	17	12	5	25
2	2	1	1	1
3	20	22	-2	4
4	24	19	5	25
5	20	17	3	9
6	15	4	11	121
7	13	1	12	144
8	20	6	14	196
9	23	6	17	289
10	4	20	-16	256
11	9	25	-16	256
12	9	6	3	9
13	4	6	-2	4
14	13	21	-8	64
15	19	12	7	49
16	4	6	-2	4
17	25	23	2	4
18	17	15	2	4
19	4	12	-8	64
20	1	1	0	0
21	11	17	-6	36
22	8	23	-15	225
23	12	15	-3	9
24	15	6	9	81
25	2	4	-2	4
		Total =		1883

Coefficient of rank correlation =0.276

Table 9: Relative Rank of Sites by Delphi and OCLEAR

Overall Scores (Ratio = 70 : 30)

Site	Delphi Rank	OCLEAR Rank	Di	Di2
1	21	16	5	25
2	4	1	3	9
3	18	18	0	0
4	13	22	-9	81
5	19	14	5	25
6	22	21	1	1
7	17	17	0	0
8	15	4	11	121
9	9	12	-3	9
10	5	6	-1	1
11	23	24	-1	1
12	20	20	0	0
13	10	10	0	0
14	25	25	0	0
15	12	11	1	1
16	8	2	6	36
17	24	23	1	1
18	11	8	3	9
19	3	5	-2	4
20	2	7	-5	25
21	7	9	-2	4
22	6	13	-7	49
23	14	12	2	4
24	16	19	-3	9
25	1	2	-1	1
		Total =		416

Coefficient of rank correlation = 0.84

Table 10: Average Point Difference of Sites by Delphi and OCLEAR

Overall Scores (Ratio 55 : 45)

Site	Delphi Rating	OCLEAR Rating	Difference	% error
1	119	152	-33	27
2	171	200	-29	17
3	125	126	-1	0.8
4	131	124	-7	5
5	125	158	-33	26
6	108	133	-25	23
7	130	152	-22	17
8	131	192	-61	47
9	143	165	-22	15
10	167	176	-9	5
11	104	78	26	25
12	123	133	-10	8
13	151	175	-24	16
14	96	79	17	18
15	135	171	-36	27
16	160	194	-34	21
17	86	102	-16	18
18	144	173	-29	20
19	171	188	-17	10
20	177	187	-10	6
21	160	172	-12	7
22	163	140	23	14
23	140	161	-21	15
24	131	139	-8	6
25	178	195	-17	9
		Total =		-402

Average Point Difference between Delphi and OCLEAR = -16

Table 11: Relative Rank of Sites by Delphi and OCLEAR

Overall Scores (Ratio = 55 : 45)

Site	Delphi Rank	OCLEAR Rank	Di	Di2
1	21	15	6	36
2	3	1	2	4
3	18	21	-3	9
4	14	22	-8	64
5	18	14	4	16
6	22	19	3	9
7	17	15	2	4
8	14	4	10	100
9	11	12	-1	1
10	5	7	-2	4
11	23	25	-2	4
12	20	19	1	1
13	9	8	1	1
14	24	24	0	0
15	13	11	2	4
16	7	3	4	16
17	25	23	2	4
18	10	9	1	1
19	3	5	-2	4
20	2	6	-4	16
21	7	10	-3	9
22	6	17	-9	81
23	12	13	-1	1
24	14	18	-4	16
25	1	2	-1	1
		Total =		505

Coefficient of rank correlation =0.806

Table 12: Average Point Difference of Sites by Delphi and OCLEAR

Overall Scores (Ratio 33 : 67)

Site	Delphi Rating	OCLEAR Rating	Difference	% error
1	125	163	-38	30
2	170	200	-30	18
3	125	120	5	4
4	127	136	-9	1
5	125	162	-37	30
6	120	155	-35	29
7	134	171	-37	28
8	129	190	-61	47
9	135	174	-39	29
10	164	164	0	0
11	123	77	46	37
12	134	154	-20	15
13	154	180	-26	17
14	114	92	22	19
15	133	175	-42	31
16	160	191	-31	19
17	83	102	-19	23
18	142	172	-30	21
19	167	185	-18	11
20	178	192	-14	8
21	155	170	-15	9
22	161	125	36	22
23	138	165	-27	19
24	134	188	-54	40
25	178	193	-15	8
Total =				-488

Average Point Difference between Delphi and OCLEAR = -19.5

Table 13: Relative Rank of Sites by Delphi and OCLEAR

Overall Scores (Ratio = 33 : 67)

Site	Delphi Rank	OCLEAR Rank	Di	Di2
1	19	16	3	9
2	3	1	2	4
3	21	22	-1	1
4	18	20	-2	4
5	20	17	3	9
6	23	18	5	25
7	14	12	2	4
8	17	5	12	144
9	12	10	2	4
10	5	15	-10	100
11	22	25	-3	9
12	15	19	-4	16
13	9	8	1	1
14	24	24	0	0
15	16	9	7	49
16	7	4	3	9
17	25	23	2	4
18	10	11	-1	1
19	4	7	-3	9
20	2	3	-1	1
21	8	13	-5	25
22	6	21	-15	225
23	11	14	-3	9
24	13	6	7	49
25	1	2	-1	1
		Total =		712

Coefficient of rank correlation =0.727

Figure 1: Delphi Panel's OTHER FACTORS:

Below is a listing of the important Other Factors as noted by the Delphi panel. Some individual factors have been merged together into similar categories.

Most frequently noted Other Factors:

* Parcel Size
* Urban Influence (including urban encroachment, size of urban area, distance from)
* Fragmentation
* Other land uses in the surrounding area (similar to the above urban influence)
* Shape of Parcel
* Present Use of Land
* Accessibility (roads, services)
* Improvements (existing or possibility of future ones, i.e. tile drainage)

Other Factors suggested:

~ Non-agricultural uses
~ Alternative Agricultural Uses
~ Environmental Hazard Potential / Considerations
~ Potential of Land
~ Farm Capital
~ Conflicting land use in area
~ Continuity of agricultural uses
~ Field crops grown (additional points if soils were not Classes 1-3)

Figure 2: Pre-Delphi Questionnaire

Code Number:_____

Pre-Delphi Questionnaire

1.	As an agricultural land expert, my skills in rating agricultural land would put me about here, relative to others.	Very highly skilled No skill at all 1 2 3 4 5 6 7
2.	As a land-use planner, my skills in rating agricultural land would put me about here, relative to others.	Very highly skilled No skill at all 1 2 3 4 5 6 7
3.	I think my ranking is, in essence, in agreement with the rest of the group.	Yes, absolutely No, not at all 1 2 3 4 5 6 7
4.	I know most of the people in the group very well.	Yes, pretty much No, not at all 1 2 3 4 5 6 7
5.	I have a definite understanding about different soil types and the effect it can have on determining good agricultural land.	Yes, a lot No, none 1 2 3 4 5 6 7
6.	I have been in agriculture for longer than most of the other people here.	Yes No 1 2 3 4 5 6 7
7.	I have a lot of experience in agriculture and soil capability.	Yes No 1 2 3 4 5 6 7
8.	I am anticipating that the Delphi is going to be a good thing for comparing agricultural land ratings.	Yes, I think so No, a waste of time 1 2 3 4 5 6 7

Figure 3: Post-Delphi Questionnaire

Name:_____

Post-Delphi Questionnaire

1.	I feel satisfied with the results in general	1 2 3 4 5 6 7	I am not really happy with the results at all.
2.	My responses benefited from the feedback.	1 2 3 4 5 6 7	My responses didn't benefit from the feedback.
3.	In general, I agreed with the ratings in the feedback.	1 2 3 4 5 6 7	I disagreed with the rates in the feedback.
4.	I could express my ideas OK this way.	1 2 3 4 5 6 7	I couldn't really write what I wanted to say.
5.	I feel as if I really wanted to talk to people.	1 2 3 4 5 6 7	I didn't feel the need to talk at all.
6.	I have a feeling people didn't use the same factors in ratings as I did.	1 2 3 4 5 6 7	I don't think people used the same factors as I did.
7.	I think the Delphi could be operational in land rating more generally.	1 2 3 4 5 6 7	I don't think it could be operational.
8.	I think it went too fast.	1 2 3 4 5 6 7	I think it went too slow.
9.	After completing this project, I now rate my skills as an agricultural expert as being very high.	1 2 3 4 5 6 7	After completing this project, I now rate my skills as an agricultural expert as being very low.
10.	As a land use planner, upon finishing this project I would say my skill level is still relatively high.	1 2 3 4 5 6 7	As a land use planner, upon finishing this project I would say my skill level is very low.